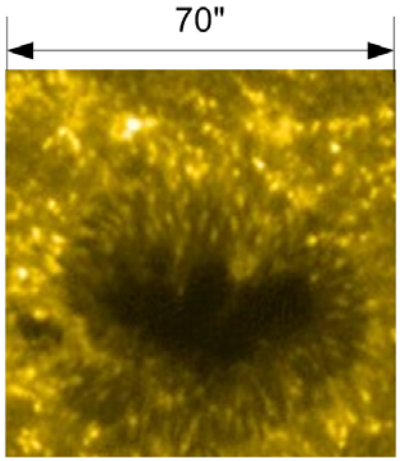
SLMS™ for Ultraviolet and Extreme Ultraviolet Imaging Applications

Phase II SBIR Contract Number NAS8-02114

Dr. David Content NASA GSFC

Advanced Lightweight Mirror for FUV Solar High Angular Resolution Photometric Imager (SHARPI)



TRACE image of sunspot
160nm, 1" resolution

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Mirror Technology Days
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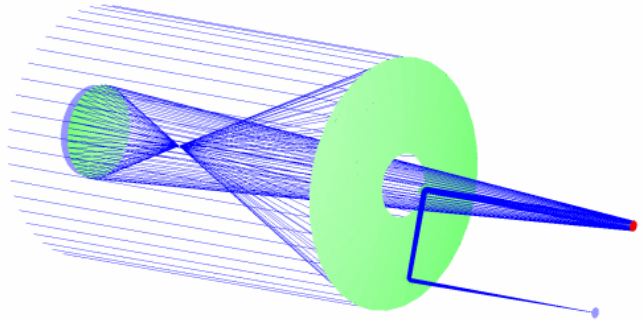
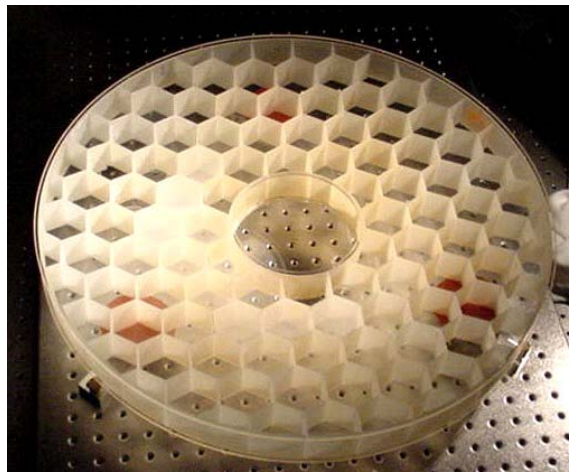
Background

- SHARPI (Solar High Angular Resolution Photometric Imager) is a concept for an experiment to achieve 0.1-arcsecond solar imaging using a lightweight, ultraprecise 55-cm telescope in the far ultraviolet (160 nm continuum, eventually emission lines including Lyman alpha and C IV).
- Kodak approach to SHARPI is based on a Gregorian system with a powered tertiary that produces a slow (f/93) final beam with the desired image scale (0.04 arsec per 10 mm pixel) – straightforward design for highly diffraction-limited system
- Baseline Kodak ULE mirror is high areal density (19.75 kg/m2) and has poor thermal conductivty

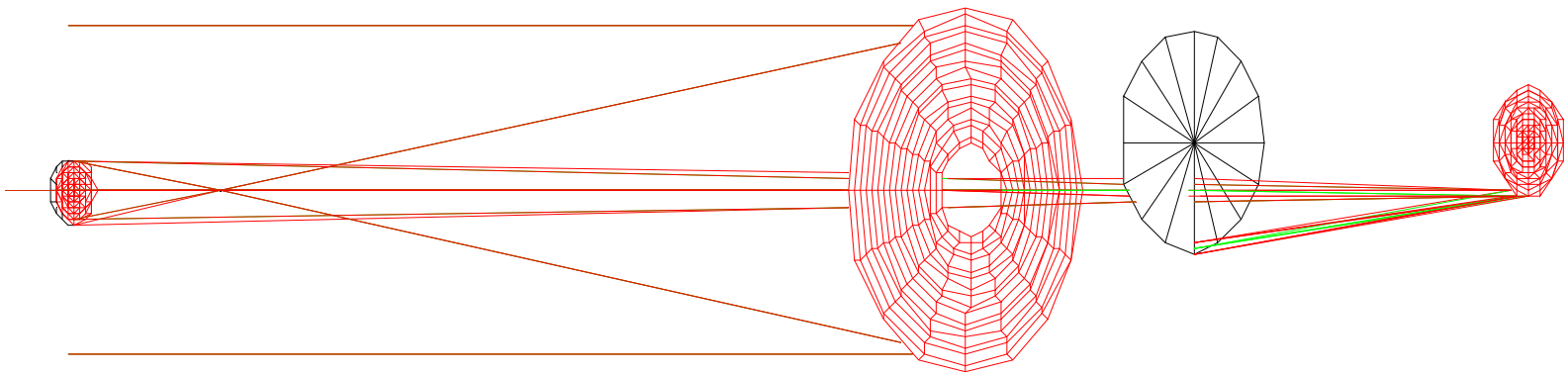




SHARPI Primary Mirror: specifications			
Material / construction		ULE / LTF	
Total mass		4.54	*kg*
Areal density		19.75	kg/m^2
Light weighting		92	%
Figure specifications			
Global surface figure error	(>10mm)	6.3	*nm* RMS
Microroughness	(1mm-1mm)	1	*nm* RMS

SBIR Objectives

- Use SLMS™ technology to improve areal density and dimensional stability
- Redesign SHARPI telescope based on SLMS™ technology using GSFC design
  - ⇒ Primary mirror: concave parabola, radius of curvature of 3000 mm
  - ⇒ Distance from primary to secondary: 1790 mm
  - ⇒ Secondary mirror: concave ellipse with vertex radius (Rv) 532.110 mm, conic constant (k) (-)0.696340, and clear aperture 97.864 mm.
  - ⇒ Optics specified for wavelengths: 0.0632 um, 0.120 um, and 0.632 um



Mirror Specifications

- Primary Mirror: 541 mm diameter, concave parabola, 3000 mm ROC (F/3) SLMS™ Demonstration Mirror with a 50 mm center hole, 19 mm thick
- Secondary Mirror, 12 cm diameter, concave ellipse, 532.11 mm ROC (K=-0.69634), single crystal silicon

Specification	Primary Mirror	Secondary Mirror
Shape	On-axis, Parabolic	On-axis, Ellipse
Physical Aperture (PA)	55 cm	12 cm
Clear Aperture	5-8 mm > than ID of center hole to 50 cm	10 cm
Surface Figure	λ/40 rms HeNe	λ/40 rms HeNe
Surface Roughness	<10 Å rms	<10 Å rms
Surface Quality (Scratch/dig)	40/20	40/20
Radius Tolerance	-	±0.5 mm
Diameter Tolerance	±2 mm	±0.2 mm

SLMS™ PM Substrate

- Largest SLMS™ Mirror Blank Produced to Date
- 1st Meniscus Design Produced to Date, 28:1 Aspect ratio
- Predicted Weight of 1.99 kg, less than ½ ULE mirror
- Predicted 1st Frequency of 616 Hertz
- Presently in the polishing cycle

Single Crystal Silicon SM

- Secondary Mirror Has Been Manufactured
- Surface Figure Requirement of .025 waves rms HeNe Has Been Met